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ABSTRACT

International collaborative learning is becoming more viable through a variety of Internet enabled software products. Group Support Systems appear to offer promise. But it is not well understood how to facilitate the teaching and learning process in electronic environments. If education is to involve an interactive process of collaborative inquiry and dialogue between remote groups of learners, then designing meaningful learning experiences presents challenges in logistics, technology support, software design, and pedagogy. To better model the facilitation process in such environments, a theoretical framework based on an extension of Adaptive Structuration Theory is suggested. This framework is then related to experiences with custom application software development using Lotus Notes Domino(TM), internal trials and a limited scale collaborative learning exercise between students at Auckland Institute of Technology and Uppsala University. The paper concludes by providing some recommendations for the redesign of the application, suggesting revisions to the collaborative process based on the framework presented, and discussing further extensions to the trials. (Contains 21 references.) (Author/AEF)

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International Collaborative Learning – The Facilitation Process

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Abstract: International collaborative learning is becoming more viable through a variety of Internet enabled software products. Group Support Systems appear to offer promise. But how to facilitate the teaching and learning process in electronic environments is not well understood. If education is to involve an interactive process of collaborative inquiry and dialogue between remote groups of learners, then how to design meaningful learning experiences presents challenges in logistics, technology support, software design, and pedagogy. To better model the facilitation process in such environments, a theoretical framework based upon an extension of Adaptive Structuration Theory is suggested. This framework is then related to experiences with custom application software development using Lotus Notes Domino™, internal trials and a limited scale collaborative learning exercise between students at Auckland Institute of Technology and Uppsala University. The paper concludes with some recommendations for redesign of the application, suggests revisions to the collaborative process based upon the framework above and discusses further extensions to the trials.

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Introduction

Numerous teaching and learning initiatives, frequently cited in conferences such as this, now include an Internet dimension. Different products such as the common "chat", "email", and "newsgroups", are being used to support collaborative learning (Siviter, Petre & Klein, 1997). In the business environment, organisations seeking to link disparate global teams are increasingly using groupware products such as Lotus Notes® (Lloyd & Whitehead 1996), and this form of product appears to have much to offer to support collaborative learning processes (Galpin & Birchall 1996). In this paper when talking of *collaborative learning*, the term is being used in the sense suggested by Siviter, Petre & Klein, 1997. They place it in the context of "groupwork", broken down into three interrelated components of "communication, collaboration and coordination". These activities in turn may be supported by *groupware* – a term "adopted to describe systems that support groupwork" (Siviter, Petre & Klein, 1997). "Groupware technologies provide electronic networks that support communication, collaboration and coordination through facilities such as information exchange, shared repositories, discussion forums and messaging. Such technologies are typically designed with an open architecture that is adaptable by end users allowing them to customize existing features and create new applications". (Orlikowski & Hofman, 1997). The Lotus Notes Domino™ application discussed in this paper can be categorised as an example of an open ended customizable groupware product, and of different time, different place groupware.

Group Support Systems (GSS) is an alternative term for groupware. Previously termed Group Decision Support Systems (GDSS), which covered particularly that class of systems known as electronic meeting systems, the GDSS research generated the ***Adaptive Structuration Theory*** model (DeSanctis & Poole, 1994) discussed in this paper. Group Support Systems has been suggested as a generic term for the field (Nunamaker et al., 1989), and defined by Whitworth (1997) as:

"GSS: any system which supports a group interaction by becoming an integral part of that interaction"

In this paper the terms GSS and groupware will be used somewhat interchangeably.

Facilitation and Group Support Systems

The Group Support Systems (GSS) field has turned its focus from more technocentric aspects, to broader study of how effective the technology is in use. Dennis and Gallupe (1993) have identified five stages of GSS research, which evidence this trend. Stage four covered field studies of the organisational impact of GSS, and stage five an in depth focus on specific aspects - one of which is *the role of the facilitator*. A further stage seems to be evolving, which focuses on organizational issues associated with the ***mutual influence*** *of technology and social processes*. This stage represents an extension from stage four's focus on the more deterministic organizational impact of GDSS. A research approach based upon the study of these *interaction effects* seems particularly suited to investigating the role of the facilitator in conjunction with GSS.

It is apparent for instance, that the complexities of GSS use in the Electronic Meeting Support context, cannot sensibly be understood without inquiry into the interaction effects between dimensions of the group and the group process, the skills of the facilitator and the technology. Likewise in asynchronous groupware contexts an analysis of interaction effects may prove a productive approach to understanding the complexities of groupwork in these distributed electronic environments. It has been suggested that "organizations need the experience of using groupware technologies in particular ways and in particular contexts to better understand how they may be most useful in practice". (Orlikowski & Hofman, 1997)

This paper discusses a general framework for analysing technology facilitation roles. It is shown how this model might be applied to the facilitator role and provide a basis for an "interactionist" model for GSS's, which may be extended to improve our understanding of the processes involved in electronic collaborative learning.

Structuring Processes and Information Technology

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Orlikowski and several colleagues have been following an interactionist line of research into Information Technology for some time. Their model of technology is structurationist in approach, based upon the work of Giddens (1984) and the concept of technology as an "occasion for structuring"(Barley, 1986). Initial work identified the reflexive nature of Information Technology (IT) in which IT both *shapes* and *is shaped by* the actions of users and the organisational context (Orlikowski, 1992). Subsequently the concepts of *metastructuring* and *technology -use mediation* (Orlikowski et al., 1995) are introduced as further sources of structure. These two key terms of the Orlikowski model are defined as:

1) ***Metastructuring*** While "The research on technology structuring...tends to focus primarily on the activities of users who shape their technology as they use it in particular contexts", [there are] "another set of activities that, although carried out by users, are not activities of use. Rather they involve the shaping of other users activities of use, a process we designate as ***Metastructuring***...The notion of metastructuring allows us to see that interventions in users' use of technology occur frequently over time, in a variety of ways, and are often very influential".(Orlikowski et al., 1995)
2) ***Technology-use mediation*** Orlikowski et al. refer to "a particular type of metastructuring, ***technology-use mediation***, and find that it structures users' use of technology by influencing their interpretations and interactions, by changing the institutional context of use and by modifying the technology itself. Because *technology-use mediation* is a sanctioned, explicit, deliberate and ongoing set of activities, we argue that it is a particularly powerful mechanism in the context of dynamic organisations, enabling rapid and customised adaptations of the technology and its use to changes in circumstances, organizational form and work practices".(Orlikowski et al., 1995)

In their study of the use of a computer conferencing system in a Japanese R&D project group (Orlikowski et al., 1995), identified four different types of mediating activities that the network administration group members performed. These were: 1) *establishment*: established role, determined and built consensus around use of the communication technology, established guidelines etc. for its use; 2) *reinforcement*: training, monitoring, and follow-up with members and the group to reinforce the established guidelines; 3) *adjustment*: on the basis of feedback obtained from members, adjusted the definitions and usage rules for specific newsgroups and occasionally added new newsgroups on request; 4) *episodic change*: twice during the project, NAGA initiated major changes to the news system as a whole.

Structuring and Facilitation Processes

"***Facilitation is a dynamic process that involves managing relationships between people, tasks and technology, as well as structuring tasks and contributing to the effective accomplishment of the meeting's outcome***"(Bostrom et al. 1993). It is argued here that both *metastructuring* and *technology-use mediation* are closely allied to the concept of facilitation in GSS environments, whether in synchronous or asynchronous modes.

The Structure of a "Meeting"

Bostrom et al. (1993) define a meeting as "a goal- or outcome-directed interaction between two or more people (teams, groups) that can take place in any of four environments (same time/same place, same time/different place, different time/same place, different time / different place)...Most GSS facilitation research has focused on face-to-face environments (same time/same place)". In this paper by contrast, the collaborative learning trials have been designed to operate as an *extended meeting*, in the different time, different place environment.

Bostrom et al. (1993) further note that "meetings rarely die, they just keep rolling along in a cycle of premeeting, meeting and postmeeting activities...The actual meeting is but one phase of a three-phase cycle of activities that constitute a meeting". This fits with the shift from the earlier decisionist view of GDSS towards more of a concept of Group Support Systems, where the group decision-making processes are more ones of managing "issue streams"(Langley, Mintzberg et al., 1995), a model better suited to asynchronous than synchronous GSS. Elaborating upon Bostrom's structure, Ackermann (1996) defines the concept of a "meeting" as broken into several stages:

- the pre-meeting stage;
- the meeting itself with three substages
    - introductory,
    - exploration and development,
    - closure
- the post-meeting stage.

Electronic Collaborative learning trial

A collaborative electronic learning trial is now briefly described to enable a concrete exercise to be related to the concepts being developed in this paper. Some pilot trials had been conducted intra-institution at Auckland Institute of Technology with an experimental *generic collaborative database* developed using Lotus Notes Domino™ (Clez., 1998). Subsequently a cross institution collaborative trial had been arranged. This trial involved a Computer Science class at Uppsala University, collaborating with a class of Business students at Auckland Institute of Technology. The Uppsala group consisted of approximately 80 students and the New Zealand group approximately 20. Both groups were to collaborate on a common task involving a role play. The Auckland group were to be business analysts consulting to a local client, while the Uppsala group were a group of software game developers, with whom the Auckland consultants had to liaise. The purpose of the exercise was to jointly develop a feasibility study for a computer game to support the client's need for a software product. The software product was to help young pharmacy assistants become more informed about the client's nailcare product range. By better diagnosis of customers' problems greater sales of products and reduced instances of misdiagnosis and nail damage were expected to result. The project scenario thus represented an opportunity for problem based learning, (Boud, 1985) based upon a live business case.
The trial took place over a 3-week period between September 22nd and October 22nd 1998. By the end of the exercise many of the students had made some progress in mastering the system, which had significant usability problems. The variety of different approaches and features used indicated a degree of ingenuity. Each combined group had come up with at least one design concept for a game, showing they had thought about the problem, variously using the database or e-mail alone to express it with.

In the definition of Bostrom et al (1993) above, this trial could be deemed a *meeting*.

Facilitation frameworks

Bostrom et al. (1993) propose a framework for understanding and investigating facilitation in GSS environments. " A given source of facilitation (external facilitator, leader, member, GSS) provides ***structures*** (e.g. agenda, procedures, GSS tools) and/or support (e.g. the facilitator administers a procedure, or deals with a disruptive participant) to a group in order to positively influence how the group accomplishes its outcomes. Structures provide an overall frame or context to activate individuals or groups to behave in a particular way. On the other hand support activities are used primarily to maintain and promote these structures, encourage effective task and relational behaviors, and deal with disruptive influences in the meeting. A facilitator, by his or her actions, attempts to influence three general targets: meeting ***process***, ***relationships***, and ***task*** outcomes. This facilitation framework may support several different levels of analysis - the individual, subgroup or entire group.

Adaptive Structuration Theory (AST) has been suggested, as a theoretical perspective which "provides a general framework for investigations" of the facilitation process. "From an AST perspective, the role of facilitation is to select and present beneficial structures to groups in a manner that encourages their faithful appropriation. A key construct within AST is appropriation. Appropriation is the process by which participants invoke or enact available structures (e.g. GSS, agenda, etc.) and thereby give meaning to them...AST posits that the success of an appropriation is determined by three dimensions, the *faithfulness* (in respect to the structure's design principles) of the appropriation, the group's *attitudes* towards the structures, and the group's *level of consensus* (i.e. agreement on how structures should be used). As we discussed earlier, a facilitator affects all three of these modes through support activities: faithfulness through promotion and maintenance of structure; attitudes through activities that develop positive affect; and consensus through monitoring the group's reactions and making appropriate adjustments." (Bostrom et al., 1993)

The AST model (DeSanctis & Poole, 1994) developed largely from a view of technology "as an occasion for structuring"(Barley, 1986), which reflects the interactions between the technology, the institutional features of the organization and the actions of individuals. The extensions to this brought through the concepts of *metastructuring* and the notion of *technology-use mediation* offer the opportunity to augment the AST model in a manner which should more directly and discretely support investigation of the facilitation process.

Before developing the AST model to accommodate these dimensions, some threads from this paper will be tied together. The facilitator role is clearly difficult to model in any simple manner, and the different frameworks contrasted so far, help to further confuse the picture. Which dimensions relate to one another, and how should they be depicted? The classic GSS design constructs of *"process support"*, *"process structure"*, *"task support,* and *"task structure"* (Nunamaker et al., 1993), who define them as follows, provide a useful starting point:

- ***"Process Support*** - refers to the communication infrastructure (media, channels, and devices, electronic or otherwise) that facilitates communication among members...such as an electronic communication channel or blackboard.
- ***Process Structure*** - refers to process techniques or rules that direct the pattern, timing or content of this communication...such as an agenda or process methodology such as nominal Group Technique.
- ***Task Support*** - refers to the information and computation infrastructure for task-related activities...such as external databases and pop-up calculators.
- ***Task Structure*** - refers to techniques, rules, or models for analyzing task related information to gain new insight...such as those within computer models or Decision Support Systems (DSS)." (Nunamaker et al., 1993)

Domains and Mechanisms for GSS Facilitation

The table below attempts to link some aspects of the structuring and facilitation processes earlier described, to assess the role of the facilitator in the context of the Uppsala – Auckland collaborative trial (Clear, 1999).

Domain	Design Contingency	Facilitation Means	Facilitation Avenue
Technology	Process Support	GSS	parallel communication group memory group and individual contributions identifiable (as opposed to the usual anonymity in GSS)
		Scanner, Photoshop™, Word™ Excel™, text editors & GSS email	media effects (photos, diagrams files etc. as well as text) Individual or mail group messages, combined with external/ internal facilitation and GSS use
		External/ internal electronic facilitation	Registration database, database forms and views, fax (as a last resort)
Institutional and Technology	Process Structure	External/ internal facilitator, telephone, fax, email and GSS (in part)	Global process structuring e.g. establish collaboration, determine client, task & groups and advise, agree collaboration window setting, remote trial coordinators, project/group leaders
		GSS	Internal process structuring e.g. project, task, document, section, discussion threads, file attachments, on-line help, questionnaires, communication & use of naming standards
Institutional and Technology	Task Structure	External/ internal facilitator and GSS in Combination	use of GSS features such as project, document, and discussion thread hierarchies, views, hyperlinks and file attach/detach features plus remote trial coordinators, & project/group

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Technology and institutional	Task Support	GSS	leaders Access to repository of std templates, group data, links with other applications e.g. Word or Excel. Specialised views and Database hierarchies. Database or email advice to groups and individuals
		External facilitator & email	

Table 1 Domains and Mechanisms for GSS facilitation

While the table shows some meaningful information, it does not provide a clear framework for understanding the facilitator role. For instance, the domain of *individual's actions*, while implicit in each of the rows, is omitted, as is the area of *relationships* and specific *support activities*.

Temporal Analysis of Mediating Activities and Relationships with GSS Facilitation

In this next analysis a time dimension is included, and the four mediation activities of Orlikowski et al. (1995) are used to structure the comparison. Illustrative examples are again drawn from the collaborative trial. (Clear, 1999)

Mediating Activity	Meeting Phase	Design Contingency	Facilitator Actions	Example
Establishment	Pre-Meeting	Process Support	Set up physical parameters and features of the technology	Confirm resources (system capacity, technical support etc.) Organise creation of collaboration database and registration database for participants
	Pre-Meeting & Meeting - introductory	Process Structure (global)	Modify institutional properties of the organization to facilitate technology assimilation	Establish collaboration parameters (scope, purpose, content, participants & timing with partnering institution's facilitator) Confirm suitability of task Determine assessment regime Communicate intentions and obtain participants' consent Ensure a match is made between the problem task, and the participants & facilitator's skill levels Determine and communicate group numbers and membership
	Pre-Meeting & Meeting - introductory		Articulate the cognitive and behavioral routines through which the technology may be appropriated by users	Provide a clearly defined task or set of objectives and corresponding agenda Create and communicate an overview of the issue/problem (via facilitator at each site and posting instructions in database Advise process to register users Clarify roles and expectations Advise of help or other tutoring features available, such as guides, sample templates, naming standards etc
Reinforcement	Meeting - exploration and development Meeting - closure	Process Support	maintain the operational fidelity of the technology	Check registration process, monitor entries, resolve access problems (forgotten passwords etc.). Check for activity level of participants, and resolve bugs, problems
		Process Structure	help users adopt and use appropriate cognitive and behavioral routines to use the technology	The GSS itself as facilitator (shaping of other user's activities of use) - enabling participants to contribute freely Providing the participants with some form of control Facilitator promotes use of the GSS system Facilitator communicates and educates re. use of GSS
Adjustment	Meeting - exploration and development Meeting - closure Post meeting	Process Support	Adjust technical features of the technology to promote use	If facilitator is a developer, may fine tune views, forms etc. to enhance usability Facilitator may advise technical support staff of problems needing attention (e.g. "out of file space" errors etc.)
	Meeting - exploration and development Meeting - closure Post meeting	Process Structure (internal) Task Support Task Structure	Alter usage rules and procedures to facilitate the use of the technology	Facilitator may decide to deviate from plan of action and use different facilities of the GSS to support the meeting activity (e.g. attached files vs. document section entries) May advise new naming or other standards to enhance use May create new features e.g. on-line questionnaire for evaluations
Episodic Change	Post meeting	Process Support	Redesign the technical functions and features of the technology	Facilitator as researcher may decide to recommend changes to clumsy or ineffective aspects of technology (e.g. upgrade views, redesign hierarchies that are too deep, improve navigation etc. Facilitator may recommend extensions or enhancements to GSS e.g. automatic links between registration and collaboration Databases to share email addresses within and between groups, or use of agents to link mail features more tightly with the GSS
	Post meeting	Process Structure	Modify institutional properties of the organization to facilitate change in technology use	Determine a general ethical approval process for collaborations Set policy regarding summative vs. formative assessment in trials Streamline the process of establishing further collaborations, or extending the model to other courses
	Post meeting	Process Structure	Redefine cognitive and behavioral routines to facilitate change in users appropriation of the technology	Facilitator may decide to use different features of the technology for next collaboration (e.g. a ranking feature may be used to judge the merits of the design proposals submitted)

Table 2 Temporal Analysis of Mediating Activities and Relationships with GSS Facilitation

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From table 2 it can be seen that ***technology-use mediation*** does add to our understanding of the facilitation process, and can be incorporated into existing perspectives on the field of GSS and group facilitation.

The Extended AST Model - Including GSS Facilitation

Returning to the AST model, the above frameworks have suggested the value of *technology-use mediation*, but are relatively static as a base for further analysis. Given the inherently dynamic nature of the facilitation process, a model capable of reflecting that is required. The base AST constructs have been built upon to incorporate the *technology-use mediation* dimension. This now gives us an **Extended AST Model,** which includes *technology-use mediation* as a further source and form of structure within the model. At this stage the concept is generic, and could include other mediation roles such as systems administrators or designers, but the term *technology-use mediator* should be read to mean *facilitator* for the purposes of this paper.

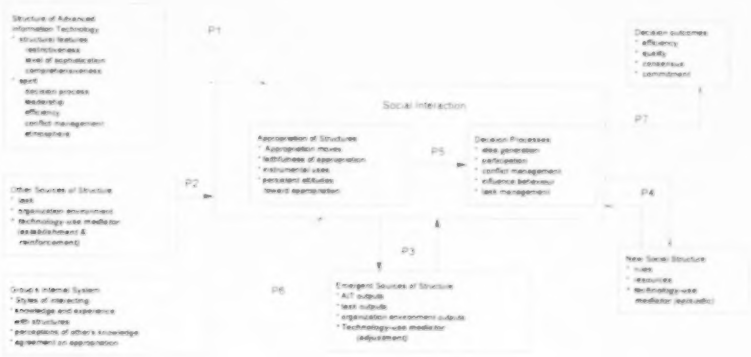

Figure 1 Summary of Major Constructs and Propositions of Extended AST Model [based upon figure 1 ex (DeSanctis & Poole, 1994)]

The modified constructs are highlighted in the redrawn model (bold italics). Basically the three constructs dealing with sources and forms of structure have been augmented;

- **Other Sources of Structure**
  - has had the *technology-use mediator* (facilitator) added, with the assumption that much of this intervention would occur during either the *establishment* or *reinforcement* modes of activity as shown in table 2 above
- **Emergent Sources of Structure**
  - has had the *technology-use mediator* (facilitator) added, with the assumption that much of this intervention would occur during the *adjustment* mode of activity from table 2
- **New Social Structure**
  - has had the *technology-use mediator* (facilitator) added, with the assumption that much of this intervention would occur during the *episodic* mode of activity from table 2

Conclusions

The complexities of developing new forms of collaborative electronic pedagogy defy simple analysis. The above model is an extension of a model developed to support research in the GSS field. It may be criticised for assuming that meetings result in decision outcomes. Nonetheless it allows for "meetings" to be broadly defined, and some aspects of the "outcomes" construct do apply to educational activities of this nature. Its strength lies in its ability to encompass the several dimensions at play in such learning environments.

For instance in the Auckland-Uppsala trial several issues required attention. The collaborative *task* needed reconsideration, its scope was too ambitious in the time available and the degree of group interactivity demanded was too low. The process of *establishing* and assigning groups needs greater structure, probably through extra workflow features of the GSS. The organising elements and views of the database need simplification, and structures for reinforcing naming standards need to be more inbuilt than open to group selection. If anything the degree of genericity needs to be reduced and the application designed to more specifically suit the educational group collaborative context. The question of *appropriation* is an interesting one, given that half the groups were not faithful to the *spirit* of the groupware application, by choosing to use the more individualistic technology option of email. The extended AST model enables such issues to be discretely analysed in depth, but within a framework which does not omit the complex interaction effects.

Initial uses of groupware for collaborative learning tend to occur at the intra-institution level (Siviter, Petre, Klein, 1997; Schrum 1997), but as inter-institutional collaborations grow, it becomes important that we find ways to increase their chances of success, and develop means to research the effectiveness of such learning practices. The author intends to continue a programme of international collaborative learning trials. This extended AST model may be one means of better designing such trials, while considering all the relevant dimensions. It may also prove a useful means to analyse the complex interactions of actors, institutional factors and technology in groupware supported collaborative learning contexts.

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